questioned whether the removal of these ribs be advised when their presence becomes clinically demonstrable.

The salient points in the case which I have presented might be summed up as follows: (1) Onset of symptoms at an unusually early age (seven years). (2) Severity of symptoms, which were practically limited to the nervous system. (3) Hypesthesia in the region supplied by the inner cord of the brachial plexus (ulnar distribution). (4) Progressive atrophy of the small muscles of the hand, including the thenar and hypothenar eminences. (5) Cervicodorsal scoliosis. (6) Stationary character of the symptoms referable to the cervical rib, in the absence of surgical intervention. (7) Demonstration of the exact location of the roots of the brachial plexus in their relation to the supernumerary rib on the left side; digital pressure upon each producing numbness and tingling in corresponding area of arm. (8) Diminution in size of the third normal rib on the left side, well shown in the radiogram. (9) Beginning symptoms due to pressure on the opposite side. (10) Surgical removal of both cervical ribs.

THE INTERPRETATION OF APHASIA.

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General Considerations. The novel and revolutionary views of Pierre Marie, the vigorous defence of the classic theories by Dejerine, the noteworthy revisions of the subject by Moutier and by von Monakow, and the brilliant discussion before the Neurological Society of Paris have aroused a keen interest in aphasia, and have given an especial zest to its study. Like others, I have studied anew the material at my disposal, and have endeavored to lay aside, for the time being, previously acquired impressions and beliefs. The interpretation of aphasia is most important, as this affects vitally our conceptions of cerebral function in its entirety. That which follows presents in brief the point of view at which I have arrived. The cases used in illustration are, of course, cited merely in outline.

Whatever view we may be disposed to take with regard to the nature of aphasia, whether we accept the older or classic view, that aphasia consists of two primarily and essentially different elements, sensory and motor, or whether we hold with Marie that aphasia is a unity the essential characteristic of which is an impairment of the faculty of speech comprehension, it will best serve the purposes of

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[1] Read at the International Medical Congress, Buda-Pest, September 1, 1909.

an analytical study if we begin with general considerations. Clearly our first task is to consider the feature, if any, common to all forms of aphasia. That such a feature exists is practically admitted by all writers. If we begin with an analysis of so-called motor or Broca's aphasia, we find, of course, first, a loss or impairment of the power of speaking, but also in addition an impairment of the power of comprehending speech, both spoken and written. I need only cite the well-known position of such stanch exponents of the classic view as Dejerine as to the existence of alexia, and of Thomas and Roux as to the failure of the comprehension of spoken speech.

Dejerine tells us that in true cortical motor aphasia or Broca's aphasia, mental reading is always affected, that the patient reads but without comprehending what he reads, and that the sight of a word does not evoke a corresponding idea in the patient's mind. As regards the comprehension of spoken speech, Dejerine tells us also that the functioning of the auditory images is not absolutely perfect; that if the examiner speaks a little rapidly to the patients, the latter often fail to grasp completely or at once the exact sense of what is said; that the same thing occurs when the sentence spoken is a little long. These statements are in keeping with general experience. Thomas and Roux have likewise shown, by their method of syllabic analysis, that the auditory interpretation of spoken speech is impaired in motor aphasics. Their method is briefly as follows: The patient being shown an object, there are pronounced before him several syllables, among which are found, it may be, the first, the last, or the intermediate syllable of the name of the object. The first syllable is quite often recognized by the aphasic, but the last or the intermediate syllables are never recognized. Failure or impairment of recognition of spoken words is thus absolutely demonstrated. Failure or impairment of recognition of speech, spoken and written, can only result in failure of speech comprehension.

That in so-called sensory or Wernicke's aphasia we have likewise an impairment of auditory and visual interpretations goes, of course, without saying, and it, therefore, results as a matter of simple logic that Broca's and Wernicke's aphasia have one symptom in common, namely, an impairment of speech comprehension, and it would further appear that such differences as may be noted are differences in degree and not in kind. From these preliminary considerations, therefore, it results that the subject which must of necessity first claim our attention is that of impairment of speech comprehension.

When we pause to consider the nature of speech comprehension or speech recognition, the theory of verbal images, auditory and visual, at once suggests itself, and yet no second thought is necessary to realize how unsatisfactory this theory is. That it explains nothing, but only obscures the problem, soon becomes apparent. Its hopeless inadequacy and insurmountable difficulties have already been pointed out by others, and I will not take time to consider them at length.

Suffice it to say that the theory of images means merely that every object seen or heard is in some way duplicated or imaged in the brain, and that these images are stored up in definite centres. If there be images of things heard and seen, there must also be images of impressions received through all of the other senses. Again, to make the application of the theory complete, we must in the case of speech also add motor images—whatever that may mean. Finally, we must suppose that there are special areas in which these images are combined, associated, or otherwise dealt with, in order to make thinking possible. No adequate conception can be formed of such images and such processes, and in truth the theory deals not so much with ideas as with words.

It is perfectly legitimate to attempt another explanation of the function of language, and although such an explanation must of necessity be largely speculative, it will be seen that it is, at least, possible to couch an explanation in physiological terms. Clearly the evolution of speech recognition or speech understanding must have been preceded by the evolution of a sense of simple sound recognition; that is, the first step must have consisted in the formation in the mind of primitive man or of his progenitors of an association of the sounds of nature with the objects or phenomena giving rise to these sounds, just as man has learned to associate the tactual qualities of the objects of nature with the objects themselves. The evolution of the faculty of sound recognition is, in a sense, therefore, analogous to the evolution of the faculty of stereognosis. In stereognosis there is an association of the tactual qualities, in sound recognition an association of acoustic qualities.

In other words, to man's knowledge of the external world, made up of the perception of tactual qualities, there is added, among other things, a knowledge of the external world made up of its qualities of sound. The primitive recognition of natural sounds, that is, the association of the sounds of nature with the phenomena giving rise to them, is a faculty which man doubtless shares with other animals. It must of necessity, in addition, form the basic substratum upon which in him the more complex function of language has been built. Certainly it seems legitimate to assume that language recognition and language comprehension have been evolved from this faculty of the primitive recognition of sounds. In ordinary sound recognition there is the immediate association of the sound with the corresponding object in nature. In the sound recognition of speech there is the recognition of definite sounds associated not directly with objects in nature, but with the conceptions of these objects. The steps by means of which spoken speech was evolved will probably never be known and will forever remain a matter of speculation. It is fair to assume, however—at least, it does no violence to any laws of probability—that the first attempts at spoken speech consisted of efforts on the part of man to reproduce sounds similar to those heard by him in nature. It would seem that in some such way as this notions and ideas were in the beginning communicated to his fellows, no doubt vaguely and imperfectly at first. Based upon such rudimentary beginnings, a progressive evolution of spoken speech and speech comprehension is readily conceivable.

ASSOCIATION. Having formed this elementary conception of the speech function, and having divested our minds entirely of the theory of speech images, let us turn our attention to disturbances of speech comprehension. In doing so, we must, of course, keep separate the differences obtaining between the failure of simple sound recognition and the failure of speech recognition. Looking upon the term stereognosis as a convenient model, simple sound recognition can properly be termed acougnosis and speech recognition logognosis. Acouagnosis and logoagnosis would mean the loss or impairment of these functions respectively, and would be analogous to stereoagnosis. The study of the speech function is in reality a study of word-sound associations, just as the study of stereognosis is the study of tactual associations. The failure of a word to call to mind the qualities of an object, and to combine these qualities into a conception of the object, must obviously depend upon a failure of association; further, this association involves, as we will see presently, much more than mere sound association. For the present, however, it may be broadly stated that the failure of the recognition of articulate sounds as words or of the meanings of phrases or sentences, is dependent upon a defect of association, that is, a defect in the power of the combination of auditory impressions—of auditory impressions among themselves and also with impressions received through other channels.

That association is involved has, of course, been many times recognized by students of aphasia, but that it is the main or essential feature of aphasia has not been generally held. Approached from this point of view, the study of aphasics becomes exceedingly interesting. The peculiarities presented by the defects of association vary greatly in different cases, both in the degree in which the symptoms are present and to some extent as to the kind of association that is defective. In order to make my meaning clear, I will use as illustration briefly the following case, which belongs to one of the large group of aphasics always at our command for study in the nervous wards of the Philadelphia General Hospital:

W. E., aged thirty-three years, a male, right-handed, was admitted to the Philadelphia General Hospital October 30, 1905. He presents the symptoms of a typical, spastic, right-sided hemiplegia with aphasia. Spontaneous speech is limited to yes and no and to an imperfect pronunciation of his name. Agraphia and alexia are also present. In other words, he presents the clinical picture of a so-called motor or Broca's aphasia. Apparently, he is able to comprehend much of what is said to him, much of what is going on about him, and conducts himself properly in the ward and at the table.

However, when his faculty of comprehending spoken language is tested in detail, as by the method of Marie, it is found that he is able to comprehend simple instructions only, such as, "Place your hand upon your head," "Place the pencil upon the paper;" at most he can carry out consecutively only two such instructions. He also fails to carry out an instruction correctly when it embraces, instead of two objects, three or more. When asked to count, he says, "One, two, three," but is unable to proceed any farther. Although he cannot read, he is asked to copy the written word "boy;" this he is unable to do. The word is then placed before him in large printed characters; he makes a drawing of the letters, but does so very imperfectly. Asked to repeat monosyllabic words, such as boy, girl, cat, man, milk, etc., he is able to say them, but with very imperfect enunciation; there is a marked dysarthria. A number of objects having been placed before him, he is unable to name any of them spontaneously. However, if he is told to point out an object, the name being plainly pronounced by me, such as spoon, knife, fork, cup, pencil, etc., he does so correctly. Now, a given object having been selected, say a tumbler, he is asked, "Is the tumbler rough?" He nods his head in the affirmative and says, "Yes," although the glass is entirely smooth. Asked now whether the tumbler is smooth, he again answers in the affirmative. Questioned a third time whether it is rough, he again answers in the affirmative. An attempt to communicate to him the facts as to this physical quality of the tumbler fails. He is similarly unable to distinguish between such qualifying words as "round" and "square." Errors were made alike if the objects were merely placed before him and if he held them in his hand. It is to be noted that a knowledge of the qualities such as I have mentioned are acquired by the sense of touch, but are normally associated in the mind with the spoken name of the object; they are part of the conception which the spoken name calls forth. Asked, Is the tumbler full of water? He says, "No," which answer is correct. The tumbler being held before him a moment later, he is asked to repeat its name. He now utters the word "water," and when the attempt is made to correct him and he is told that the name is tumbler or glass, he shakes his head in the negative and says, "No."

A number of pieces of colored chalk, blue, white, yellow, and red, were now added to the objects on the table. Asked to pick up the blue chalk and place it on a piece of paper before him, he picked up the yellow chalk. This test was varied and repeated very many times; and the percentage of errors was so large as to lead to the inference that he did not recognize the qualifying words signifying color. It was also noticed that if the instruction at any time embodied three factors, he usually failed in the proper sequence of the things he did; that is, he would become confused and make errors. As far as it was possible to determine, he was not color blind.

He was next tested as to his ability to distinguish prepositions and phrases indicating relations of space. Thus, a tumbler having been placed in his hand, he was asked to hold the tumbler *above* the table, to hold it *below* the table, to hold it in *front* or to the *side* of the table. Here the percentage of failures was so large as to justify the inference that he did not recognize these words or phrases at all. A similar result was experienced in a test involving the difference between such prepositions as *in* and *on*.

Further, it was easily demonstrated that his recognition of verbs was also very limited. He recognized "put," "is," "hold," "pick up," but he could not make any differentiations of tense. Thus, when he was tested as to "is" and "was," he failed, and in the few instances in which he succeeded his answers were evidently the result of pure guess-work. For instance, a pencil having been laid upon a piece of paper before him, he was asked, "*Is* the pencil upon the paper?" and again, the pencil being removed, "*Was* the pencil upon the paper?" This test, simple in character, was repeated many times; his answers were given "yes" or "no" at random, and there could be no doubt as to his failure to distinguish between these elementary differences of tense.

Tests with other aphasics yielded similar although of necessity varying results, the results being somewhat in proportion to the impairment of the general comprehension, as instanced by the failure of the patient to carry out simple or serial instructions. When the patient was able to carry out complex instructions or a number of serial instructions consecutively, it was usually found that he preserved some knowledge of words and phrases indicating physical qualities, and also relations of time and space; that is, there seemed to be a proportionate recognition of adjectives, prepositions, qualifying phrases, and the ability to make at least simple distinctions of tense. This is well illustrated by the following case:

L. J., aged forty-nine years. Here there is likewise a Broca's aphasia. The loss of motor speech is so complete that the patient cannot say even "yes" or give his name; he says "do" for "no;" when urged to speak, he says "dindo," which seems to be his stock expression.

Question. "What is your name?"

Answer unintelligible.

Q. "Can you say any words at all?"

A. Shakes his head in the negative. Is emotional and weeps.

Q. "Say 'yes.'"

A. Fails.

Q. "Say 'no.'"

A. "Do."

Q. "Say 'all right.'"

A. "Aw aw da."

Q. "Stand up, take your chair, and bring it toward me."

Complies perfectly with the instruction.

Q. "Strike on the floor three times with your cane, then sit down and place your cane on your knee."

Complies perfectly.

Q. "Rise from your chair, take three steps toward me, go back, turn your chair so that it faces the wall, and then sit down."

Complies perfectly.

Three pieces of paper of unequal sizes having been placed on the table, he is asked to take the largest piece, to crumple it and throw it on the floor, to take the smallest piece and hand it to the nurse, and to take the medium-sized piece and to hand it to me. He compies with the instruction except that he not only crumples the piece of paper that he throws on the floor, but also the pieces that he hands to the nurse and myself. When the tests are made still more complex, he invariably fails.

A group of objects having been placed upon the table before him, he correctly indicates the objects as they are named by me. He also recognizes words indicating the physical qualities, such as smooth and rough as applied to a glass, and such physical qualities as color. He also recognizes such words and phrases as indicate space relations, that is, "above," "below," "in front of," "to the side of," etc.

He can recognize his own name when written before him. He recognizes the word "hand" when this is shown to him in either written or printed characters. This is also true of other simple monosyllabic words indicating objects. However, if a sentence is written, such as "Raise your left hand," he cannot construe it and fails to comply with the instruction. In other words, this patient, whose sound recognition of speech has suffered relatively moderately, but who has a very marked loss of motor speech, has associated with this loss of motor speech a very pronounced alexia, an alexia, too, which is especially evident the moment he attempts to combine even a limited number of words into a phrase or sentence. He is also unable to tell the time.

The peculiar inability of the aphasic to combine words into phrases and sentences is shown in a number of ways. Thus, W. E. is able to say after me each of the following words *separately:*

"The," "pencil," "is," "on," "the," "paper." While he is able to pronounce these words with sufficient clearness to be readily understood, he is utterly unable to *combine* them into the sentence "The pencil is on the paper." The most that he can do after repeated urging is to say, imperfectly, "pencil paper."

The following case shows the same thing to be true in the instance of written words:

J. McN., aged fifty-seven years, presents a marked right-sided hemiplegia with contractures and aphasia. His speech is limited to "yes." On rare occasions, when asked, "How are you?" he replies, "All right." He recognizes his spoken name, for he turns around when addressed. Asked whether his name is John, he says, "Yes." Asked whether it is William, he first shakes his head in the negative, but afterward appears to be confused and in doubt. He is unable to comply with simple instructions, such as, "Raise your left hand." Asked to put out his tongue or to shut his eyes, he fails to comply. He will, however, repeat various gestures made before him in pantomime, but his repetition of the gestures is imperfect; his gestures are, of course, made with the left hand. He feeds himself and appears to recognize such utensils as a spoon and cup, and to use them properly. However, when an open-faced watch is placed in his hand with the face down, he makes no attempt to turn the watch over so that he can see its face. When the face is turned up for him, he looks at the watch, smiles, but gives no sign of recognition. When he is approached from behind and the watch—a loud-ticking one—is held close to his ear, although not touching him, he again fails to give the least sign of recognition. He is not deaf, as is readily demonstrated when his name is pronounced in an ordinary voice, as he immediately turns. He appears to recognize the various articles of his clothing, and assists the nurse when he is being dressed. He has complete agraphia. An attempt to write leads merely to the forming of unintelligible markings upon the paper. He is, however, able to read aloud single words, such as "Ireland," "Lawrence," "Jordan," "leaf," "house," "head," "hand." These words, to our surprise, he pronounces, and although the pronunciation is dysarthric, they can readily be understood. If, however, a simple instruction be written before him, such as, "Put your hand on your head," he fails to comply, just as he does when the instruction is given to him verbally. In other words, he has no power to combine the individual words which he is able to read. He cannot grasp a phrase, either spoken or written, so as to enable him to comply or perform an instruction, no matter how simple.

REËNFORCEMENT. Every one who has studied aphasics has noted that the symptoms presented by an individual case of aphasia not infrequently vary. This fact may be observed at different examinations or may be noted in the progress of one and the same examination. While the degree of variation is usually not great, both the fact of its existence and the character of the change are important as throwing an additional light on the nature of aphasia. The variation may be due to several causes: (1) A patient subjected to an examination, even if not very prolonged, may sooner or later present signs of fatigue, that is, the answers or compliance with tests, at first successful, may, as the examination proceeds, fail; (2) it may be noted in repeated examinations that the patient responds more and more readily; in other words, that the examinations are themselves re-training or reëducating the patient. There is, however, a third cause of variation of symptoms much more interesting and much more important than either of these and the phenomena of which can best be explained by a theory of reënforcement.

Every one is surprised now and then by the emission of words and phrases by the aphasic spontaneously when previous examinations had failed to elicit anything more than perhaps "yes" or "no" or some simple expletives. That such phrases are heard under the stimulation of unusual excitement is well known. For instance, one of my patients, whose single utterance is "yes," when I insisted upon his saying the word "no," failed as at previous examinations. Finally, upon my insisting repeatedly and emphatically, his face flushed and he suddenly shouted, "I can't say no," at the same time shaking his head. While I have studied this man a great many times, this is the only sentence that I have ever heard him utter. It is fair to assume that in this instance the general cerebral activity had been forcibly aroused or stimulated, and that this had had the effect of reënforcing the impaired speech function; that is, inhibition had been momentarily overcome by a powerful reënforcing wave.

The curious instance of the singing aphasics can only be met by a similar explanation. For instance, I had under my care some years ago a Broca aphasic, whose speech was limited to "yes," "no," and a few brief expletives. He could, however, sing—among other things—Auld Lang Syne, carrying the air well and enunciating each word clearly. No other explanation, it would seem to me, than that of reënforcement overcoming inhibition can apply in such a case.

Reënforcement in aphasia can be illustrated in a number of other ways. For instance, one of my aphasics who at one examination was able to count as far as three, at a subsequent examination, after he had been stimulated by a number of tests, counted as far as sixteen. Here, again, we have doubtless to apply a principle of reënforcement. Again, another of my aphasics counts as far as twenty. He does so apparently without effort, but becomes confused when twenty or twenty-one is reached. Further, he enunciates the names of the various numbers quite correctly during the act of counting. If, now, I allow a moment or two to elapse, and then ask him to repeat after me one of the intermediate numbers, say thirteen, *separately*, he fails. He makes a sound, it is true, but it is quite unintelligible. Tested with other separate numbers, the result is the same. It would appear that in this case the uttering of the number in serial sequence is, after the start is made, largely a matter of reënforcement. Counting is taught in childhood in such a way that a serial association is early formed in the mind—a serial association basic and strong. In our patient, the count having been started, each number evokes its neighbor in the series; each reënforces the one that follows and necessarily along a pathway of time-worn association. Taken out of its sequence, a number is either not enunciated at all or the enuciation is dysarthric. In our patient it requires the reënforcement resulting from the formation of the previous numbers to make the emission of the given number possible.

The existence of more complex associations and reënforcements can be illustrated in still other ways.

C. A., aged fifty-six years, who early in May, 1908, suffered from a paralysis of the entire right side, can answer "yes" and "no," give his name imperfectly, and can utter a limited number of other words. His enunciation is markedly dysarthric. His name is Christopher A.

Q. "What is your name?"

A. "Christian."

Q. "Is your name not Christopher?"

A. "Yes, Christopher."

Q. "Have you no other name?"

A. "No." (After an interval) "Almus" (incorrect).

Repeated efforts to have him pronounce his name in full and correctly fail.

Q. "What is your age?"

A. "Thirty-eight." (As already noted, his age is fifty-six.)

Q. "What is your business?"

A. After a long delay he answers "Carpenter."

Q. "Where did you work last?"

Answer unintelligible.

Q. "Are you comfortable?"

A. "Yes."

Q. "Do you want anything?"

A. "No."

Q. "How long have you been in the hospital?"

A. "Couldn't tell."

Q. "Can you count on your fingers?"

A. "Yes."

Q. "Count your age on your fingers."

A. Now counts aloud as far as 29, jumps to 40, and then goes back to 21.

He is unable to say the word pencil, although he recognizes the pencil and correctly points at it. When, however, he takes hold of the pencil, handling it correctly, he says, "pencil." The same thing is noted in the case of a key ring. He looks at it, is unable to say the word, but after handling the object for a time says "ring." It would seem as though we have here to do with both stereognostic and visual reënforcement. The visual recognition and naming, by an aphasic, of an object is in a sense the result of a visual reënforcement, and in a similar sense this must be true of its tactual recognition. When the words pencil, keys, and ring are said before him, he correctly points out the objects. Other tests were made with this patient with regard to reënforcement by taste and smell. Although not very successful, they were very suggestive. In the case of syrup, for instance, which was poured out before him, but which he would not or could not name, he at once called "molasses" as soon as he tasted it. In a test made with vinegar, concerning which he would say nothing from merely looking at it or smelling it, he finally called "cider" when he tasted it. He is unable to read even his own name in either printed or written characters. He cannot write or copy. When urged to write, he makes with his left hand the letter "C" backward, as in mirror writing. Asked to write twenty, he puts down 01. He will repeat imperfectly a few simple words, but he cannot combine them into sentences. Once only he repeated after me the sentence, "I am well."

In this instance there appeared to be an unmistakable reënforcement of the word-forming power or of word emission by the perception of tactual qualities in two instances, and by the perception of those of taste in a third. Responses were also at times obtained by urging and insisting upon an answer, although here readiness of fatigue interfered with the results.

The following case, which presents a marked loss of speech comprehension, but no impairment of emissive speech, is interesting because of the failure of both tactual and visual reënforcement to enable the patient to name objects. It is not improbable that the failure was related to the intensity of the loss of speech comprehension.

M. J. O'B., aged forty years, had been admitted to the nervous wards of the Philadelphia General Hospital, with an unsatisfactory history of an injury to the back of the head some months before and the subsequent development of convulsive attacks and "loss of memory." When questioned, a difficulty of speech comprehension at once becomes apparent, although no difficulty of emissive speech, no difficulty of enunciation, no anarthria, can be detected.

Briefly tested at first by a series of instructions, according to the method of Marie, it is found that he frequently fails to carry out simple instructions, such as picking up an object from the table. He invariably fails when the instructions embody two consecutive acts. Thus, asked to pick up a piece of paper from the table, he may comply, but if asked to pick up the paper and throw it into the waste basket, to crumple it in his hand, or to mark it with a pencil, he invariably fails. The same result ensues if the number of the objects with which he has to deal is increased. Among other things, he was questioned as follows:

Q. "What is your name?"

A. Answers correctly.

Q. "Where were you born?"

Looks about him for some time, and finally answers, "Thirty."

When the question is repeated in different ways, he finally answers, "Don't understand."

When the question is now modified, "Were you born in America or Ireland?" he answers, "I was born in Camden."

Q. "Why can you answer as to your place of birth at one time and not at another?"

A. "Sometimes I can and sometimes I can't."

Q. "Are your father and mother living?"

A. "My mother is, my father dead."

Q. "Where was your father born?"

The patient again assumes a look as though he did not comprehend, points back of himself, and finally says, "You can say, I can't."

When the word Ireland is suggested, he nods his head in the affirmative. He is then able to repeat the word Ireland immediately after it has been said before him, and the enunciation is clear and distinct.

Q. "What is your business?"

A. "Buy barrels."

Q. "What do you do with them?"

A. "Work for my brother."

Q. "What did you do with them?"

A. "Sold them."

Q. "Have you any relatives?"

A. "Yes."

Q. "Who are they?"

A. "A man."

Q. "What is he?"

A. "He makes those." (Rises and points to the spigot of the water cooler.)

Q. "What is this man to you?"

A. Again points to the spigot of the water cooler.

Q. "Is he your father?"

A. "Yes."

Q. "Your father is dead. Is he your brother?"

A. "Yes, brother."

He then himself asks the question, "Do you mean Frank?" and then answers the question himself, saying "Yes, brother."

Q. "Are you sitting or standing at present?"

A. No answer.

Q. "Am I sitting or standing at present?"

A. "Yes sir."

Q. "What day is this?"

A. "Thursday" (correct).

Q. "Is it day or night?"

A. "Day."

Q. "Is it morning or afternoon?"

A. "Morning" (correct).

Q. "What is this?" (indicating a chair).

A. "I know, but can't say."

He is now asked to touch it, to lift it, and to sit upon it, but is still unable to give the name.

Q. Asked again, "What is it?"

A. "I can't say."

Q. "What is it for?"

A. "To sit on."

Q. "Point to a table in this room." (The room contains two tables and a desk.)

A. "There isn't any."

Q. "Is there a desk?"

Points correctly at the desk.

Q. "Is this a table?" (indicating a chair).

A. "No."

Q. "Is it a desk?"

A. "No." (Patient again points to the desk.)

Q. "Is it a broom?"

A. "No."

Q. "What is a broom for?"

A. "Anything that is dirty."

Q. "Is this a chair?" (chair indicated).

A. "No."

Q. "What is this?" (indicating a knife).

A. "Can't say."

Q. "What is it for?"

A. "To cut with."

Q. When the knife is placed in his hand, he is equally unable to name it.

Q. "Is it a spoon?"

A. "Can't say."

Q. "What is this?" (handing him a watch). He looks at it, feels it, and places it to his ear, but cannot say what it is. Finally, he says, "I know what it is, but can't say it."

He can repeat readily the names of objects when they are laid before him, but his ability to call the names to mind spontaneously is greatly impaired. When the word "pencil" is placed before him in printed characters, he replies, "Cannot say it." Asked then to point out the object for which the printed word stands, he fails to do so, though there are several pencils on the table.

He correctly indicates, as already stated, his hand, his head, indicates correctly a chair, but fails to indicate a clock, although a large clock is almost directly in front of him. He is able to write his name, but cannot write sentences spontaneously or write at dictation. He copies by drawing the letters imperfectly of words placed before him.

He can read monosyllabic words, such as hand and head, when these are in large written or printed characters. He fails, however, to understand this written sentence: "Put your hand on your head." Cannot construe the sentence and fails to comply with the instruction. When he is told verbally to raise his hand and place it upon his head, he complies, but only after much delay and after repetition of the instruction. He fails in very simple problems of arithmetic, although he forms the figures very well.

In this case, which would, of course, be included in the classical division of the sensory aphasias and in which anomia would be considered as the leading feature, we have of special interest: (1) The occasional breaking through of answers or even spontaneous statements when avenues of reënforcement are opened up by the excitement and stimulation of the examination. (2) Contrary to what we observed in the case C. A., we note failure of tactual reënforcement to bring about the formation and emission of the name when the visual reënforcement fails, and (3) the very marked inability to execute serial instructions. Both of the latter features are doubtless related directly to the degree of the impairment of the speech comprehension.

We are justified from clinical evidence alone in the inference that the area of the cortex concerned in speech recognition is normally in close relation with other areas concerned in the recognition of the physical qualities of the external world. That this relation is intimate in the case of the visual and tactual functions goes without saying; that it also exists in the functions of taste and smell seems equally incontrovertible. The loss of the ability to associate properly, for instance, articulate sounds with tactual qualities, must lie in a break, structural or functional, in the relations between Wernicke's region, on the one hand, and the region of tactual recognition or stereognosis on the other. The same must be true in the case of visual recognition and of recognition by the other senses. It would appear from these considerations that the function of speech comprehension must be very general in its character, one in which very extensive regions of the brain are concerned; and this fact must be borne in mind in estimating the effects of a limited lesion. Here the dangers and difficulties of interpretation are great. The symptoms present may in part owe their existence to disturbances in the relations between the area involved and quite distant regions of the brain.

The phenomena of reënforcement seem to prove that some, at least, of these disturbances of relation are functional; if the break were always structural, reënforcement could at no time occur. Many of the symptoms, therefore, noted in aphasics must be due to inhibition, and the theory of the diaschisis advanced by von Monakow shows very clearly how this change or splitting off of function, or, better still, *suspension* of function, may occur. On no other basis than that of the overcoming of inhibition are we able to explain the various phenomena of reënforcement. In order that reënforcement may occur, a pathway cannot be altogether closed, but need be only so much influenced by a lesion as to impede or suspend for the time being association. Clearly it is association which forms the chief problem in the study of aphasia.

EMISSIVE SPEECH. In some of the illustrations I have used, reënforcement has of necessity been considered in relation to emissive or spoken speech. When we turn our attention to this faculty, we find that clinical studies reveal additional facts of exceeding interest. For comparison I selected: (1) A typical case of pseudobulbar palsy; (2) a case which appeared at first sight to be a pure motor or subcortical aphasia; and (3) a typical case of Broca's aphasia. The views of Marie in regard to anarthria urgently suggested such a comparison.

In outline the case of pseudobulbar palsy is briefly as follows:

T. R., aged thirty-five years, suffered a year before his admission to the Philadelphia Hospital from an apoplectiform seizure, which left him with a mild left hemiplegia, from which he rapidly recovered. Three months later he had a second stroke, this time affecting the right side, but also transient in character. After the second stroke it was noticed that his speech was very indistinct. His general condition improved decidedly, but the difficulty in the speech persisted.

When admitted, it was noted that his gait is somewhat shuffling, his legs slightly spastic. The knee-jerks are increased and there are an ankle clonus and Babinski reaction on the left side. The patient is unable to extend his lips or to protrude his tongue beyond the lips. He usually holds his mouth open; has difficulty in holding liquids in his mouth and in swallowing; cannot close the mouth firmly; cannot whistle. The tongue presents no atrophy, but the patient's power to direct it upward, downward, or to either side is greatly impaired. Examination of the larynx fails to reveal positive findings; at one time an abductor weakness, at another an adductor weakness, appears to be present.

It is important also to record that the patient is constantly either smiling or laughing; automatic laughter is a marked feature of his case. To some extent this laughter is reflected in the general tone of the patient, who in reply to questions says that he is happy and not depressed.

When his speech is investigated, it is found that he is able imperfectly to form vowels and still more imperfectly consonants; indeed, the ability to form consonants is so feeble that it can hardly be said to exist. Repeated examinations, however, have made me more or less familiar with his peculiarities, and I am able to interpret much of what he says or tries to say, imperfect as this is.

Of course, there is here no question of aphasia, properly speaking, no failure of speech comprehension. He understands everything that is said to him, he reads, writes, and tells time correctly. He carries out verbal serial instructions correctly as long as these embody only three factors. If they embody four factors, he fails. If the serial instructions are written instead of verbal, he again complies correctly; he again fails, however, when the number of factors is four, unless he stops in course repeatedly to read his instructions. It is also noted that while he is able to do simple sums in arithmetic, he fails as soon as the additions or subtractions become at all complicated. At one time, also, as do aphasics so frequently, he began an addition at the left hand column; possibly embarrassment and confusion played some role in this gross error, which he did not himself perceive; the test was made at the blackboard, and in the presence of a class of students. However, his marked arithmetical incompetence is rather remarkable, inasmuch as he was by profession a draughtsman, and, if he is to be believed, well educated. The question arises, of course, whether in lesions so gross as those of pseudobulbar palsy there is not necessarily some general mental impairment. The fact, however, whatever its explanation, is exceedingly interesting. It becomes especially so when we turn our attention to the next case, the one which, at first sight, seems to be one of pure or subcortical motor aphasia.

R. J., aged sixty-three years, male, right-handed, suffered six weeks before admission to the hospital with a right-sided hemiplegia. This hemiplegia was slight and of short duration. At the time of his admission to the hospital his physical examination was negative, save that the grip of the right hand was not quite as good as the left, and that there was some flattening of the right lower face. He could not retract the right angle of the mouth as well as the left. He could not whistle. He could protrude the tongue well and move it in all directions. He suffered, however, from a marked impairment of speech, and was at once classified as a "motor aphasic."

Examined in detail, it is found that he presents a high degree of anarthria. This is so great as strikingly to resemble the anarthria of the pseudobulbar case just cited. He gives his name as Josup Josun, which is intended for Robert Johnson; pronounces "yes" at times correctly, at times as "gess," and "no" frequently as "do." Enunciation is very indistinct and difficult to follow; often final syllables are not pronounced at all. He counts aloud, but with marked dysarthria: bon (1), tno (2), tee (3), our (4), fiz (5), chick (6), cheven (7), eat (8), etc. He recognizes objects and, making allowance for his high degree of anarthria, names them correctly. He can repeat after me short sentences, but with, of course, marked anarthria. When the sentence contains two phrases, the repetition is very incomplete. When the sentence contains three phrases, each embodying a separate idea, he always fails; what he says becomes completely unintelligible.

The patient is on duty as cook for the night watchmen; the head nurse states that in the mornings he asks for his supplies in one word, or in separate words, never in phrases or sentences. Frequently, instead of attempting to communicate his wants by word of mouth, he will write them; *e. g.*, "Kindly give me some sugar. Dining-room men used mine." Again, "The men in the dining room stopped me taking potatoes for the night men. They grumble when they don't get potatoes. They cook them for supper and breakfast." It should be added that he discharges his duties as cook well. He can also write at dictation simple words. In writing sentences, he usually begins properly, but soon makes mistakes. Tested verbally as to carrying out serial instructions, he complies promptly and readily.

In this respect he does not differ in the least from the pseudobulbar case just cited. If, however—and this is the important point in his case next to the anarthria—if he be handed a series of *written* instructions, he carries them out imperfectly, and even with the written instructions in his hand he sometimes fails altogether. In other words, he betrays an alexia—an alexia which consists in the inability to *comprehend* properly the written instructions. When he attempts to read aloud, only a few words here and there can be understood.

Here, then, is a case the anarthria of which closely resembles that of pseudobulbar palsy, and which is, notwithstanding, associated with an alexia present in a degree; but for this symptom the case would fit exactly into the group of subcortical or pure motor aphasias. Does he not, however, even in this respect resemble the case of pseudobulbar palsy just cited? For, in the latter, let us recall there was also a distinct difficulty in the interpretation of written instructions. The case of R. J. suggests to our minds the query, Does *pure* motor aphasia really exist in nature? Personally, I have never met with it; is it not always pseudobulbar palsy?

The patient suffering from pseudobulbar palsy, we will recall, was constantly laughing; indeed, he presents a typical instance of the automatic laughter not infrequently met with in pseudobulbar palsy. In our third patient we have an instance of a motor aphasic who, like the pseudobulbar case, is constantly laughing. Briefly, W. W., aged fifty-seven years, right-handed, right-sided hemiplegic, has a pronounced anarthria, his speech being limited to "yes" and "do" (for "no"); he understands much that is said to him, executing serial instructions fairly well; he suffers, however, from a pronounced alexia. While he is able to read an occasional isolated word, he fails utterly to construe a sentence and fails, therefore, in executing written instructions. Other than this, he presents no peculiarities save that he laughs, laughs automatically, laughs just as much as does the patient with pseudobulbar palsy. I have occasionally met aphasics who laughed readily, laughed a great deal, but I have never met one who laughs quite as much as W. W. On the other hand, as is well known, there are aphasics who weep readily—who are readily provoked to weeping during an examination. Of course, it may be claimed that laughter and weeping in pseudobulbar palsy and laughter and weeping in aphasia are merely analogous facts and bear no clinical or pathological relations to each other. To me, however, the facts are most suggestive, both clinically and pathologically, especially when we take into consideration, on the one hand, the known involvement of the lenticula in pseudobulbar palsy, and the involvement of the lenticula as claimed in the anarthria of Marie and found to exist among others in one of my own (published) cases. The pathology of automatic laughter and weeping is, of course, not known, that is, if it have a pathology apart from that of pseudobulbar palsy; that we meet with it at times in Broca's aphasia is not surprising if some relation between the two affections be admitted.

It might be claimed that our case of pseudobulbar palsy is in reality a case of aphasia; that this is shown by the fact that the first stroke, which was left-sided, was not followed by the speech disturbance, but that the latter ensued only upon the second or right-sided stroke. However, the fact that both strokes were slight and transient in character, as they so often are in pseudobulbar palsy, so as to leave little subsequent physical evidence, and the further fact that the patient presents distinct weakness of the lips, that he is unable to hold liquids in his mouth, has difficulty in swallowing, cannot close his mouth firmly, cannot whistle, and, although the tongue presents no atrophy, that he cannot protrude it beyond the lips and cannot move it well up or down or to either side, prove conclusively that the case is one of pseudobulbar palsy and not aphasia, and yet some of the clinical findings are, as already pointed out, suggestive of aphasia.

THE SIGNIFICANCE OF ALEXIA. To my knowledge no attempt has ever been made adequately to explain the intimate association of the loss of motor speech and alexia. It is in my experience a striking fact that in by far the larger number of cases of Broca's aphasia the loss of the power to read exceeds—and usually decidedly—the loss of the power to comprehend spoken speech. If the loss of motor speech depends upon lesion of the third frontal convolution, why this remarkable association with alexia? Is it not a more reasonable explanation to assume that the lesion, whatever its situation, is one which interferes with speech comprehension—the one symptom common to all aphasics—and that the form of speech comprehension which of necessity suffers most is the comprehension of *written* speech? Comprehension of spoken speech is a faculty as old as the race, comprehension of written speech at most an acquisition of a few generations. Which faculty would we expect, therefore, to suffer most? Is it not natural that the infinitely older and basic faculty of the comprehension of spoken speech should frequently suffer less, or even little, while the power to comprehend written speech is literally swept away?

It is quite evident that in the study of aphasia general conceptions of cerebral function must ever be kept in mind, lest special reasoning lead us too far astray. It is for this reason that general procedures, such as the serial instructions of Marie, often prove so valuable. The serial instructions are a test, (1) of the general faculty of speech comprehension; (2) of the presence of apractic elements; (3) of the general intellectual integrity. Apraxia, when present in aphasia, means necessarily a lesion of great extent or a lesion involving widely diffused associations. General intellectual impairment, of course, argues for a still more extensive diffusion of the morbid condition.

The application of the theory of the diaschisis of von Monakow enables us to explain many of the vagaries of the lesions of aphasia.

How greatly the lesions vary, both in location and size, is well known; this is especially apparent in the revisions of von Monakow and of Moutier. In a measure the theory of the diaschisis enables us to reconcile these variations, and it also enables us to explain the suspension of function with subsequent recovery. It cannot, however, enable us to upbuild a function once destroyed. Thus, given a lesion of the third frontal convolution, with loss of the emissive speech function and subsequent recovery of this function, diaschisis cannot be invoked to explain the recovery of that function *as the function of the part destroyed,* namely, of the third frontal convolution. To maintain that the neighboring cortical areas have assumed the function, or that the function has been restored because the individual happened to be ambidextrous, is virtually begging the question. The obvious objections to such explanations have already been pointed out by others. However, whether the third frontal is or is not concerned in aphasia is really not an important matter. If it is, the clinical and pathological evidence should be forthcoming. All will agree, I think, that this evidence is at the present day most meagre. It is certainly significant that permanent speech disturbances do not follow lesions limited to the third frontal convolution. It is quite safe to assert that thus far not a single unequivocal case, a case free from criticism, has appeared in the literature. As Marie has pointed out, and later Pick and von Monakow, permanent disturbances of speech associated with lesion of the third frontal convolution are only present in cases in which the lesion is deeply penetrating and extensive in its distribution. Negative cases, that is, non-involvement of the third frontal convolution, on the other hand, are not at all infrequent. I have myself only recently acquired two such specimens; a third I placed on record a few years ago.

In the foregoing paragraphs I have purposely refrained from the use of terms implying special theories, such as word blindness, word deafness, transcortical, subcortical, or conduction aphasia, or paraphasia. I have thought it wiser to lay stress upon general facts such as in my judgment lend clearness to our conceptions of the speech function and react indirectly upon our conceptions of cerebral activities in general.